DESIGN OF GEOGRAPHIC-BASED DECISION SUPPORT SYSTEM FOR ROAD REPAIRMENT WITH GDSS METHOD: CASE STUDY IN BANDUNG DISTRICT

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Abstract—In an effort to make road improvements effective and efficient in Bandung Regency, the Public Works Service performed road repairs based on the most damaged areas. In the implementation there is a problem of limited information possessed by the Office of Public Works Bandung Regency so that road improvements were not effective and efficient. In this study developed information systems support the repair of damaged roads geographically-damaged road including data input damaged by the public and admin system, road damage in geographic view, can result in road improvement recommendation, and road damage management information system

Keywords—geographic information system, decision support system, broken roads, gdss, information system for government, roads information system

I. INTRODUCTION

The number of damaged roads in Bandung Regency is high, especially in the Deyeuukolot, Bojongsoang and other areas that are often submerged by floods also add the number of damaged roads that exist in Bandung regency. Damaged road is a serious problem in the Indonesia area, especially in Bandung there are quite a lot of roads damaged that access the main road in Bandung Regency is very bad roads damaged and perforated roads. Even most of the highways in the area of Bandung Regency are totally destroyed. [1] Damaged roads in Bandung Regency have potential to cause the traffic accidents and congestion that can hamper the economy of the community such as access to bad sights it makes less tourist attractions are less desirable [2]. Although the condition of the driver is fit and the condition of the vehicle is roadworthy, accidents can also occur due to the condition of road infrastructure. [3] The process of repairing damaged roads have to be effective and efficient, the Bandung District Public Works Office repaired the roads based on the most damaged areas, but with the limited information possessed by the Office of Public Works Bandung Regency, so the road improvements in Bandung regency did not become effective and efficient. [4].

According to the data of Bandung Public Works Office there are 115 damaged roads and there are many more that have not been recorded since the area of Bandung Regency is so wide, that makes it more difficult for the government to record it. [5] With the existence of geographic-based decision support system on damaged roads in Bandung Regency, it can assist the Public Works Office in making decisions by involving the public in reporting damaged roads, so that road data damaged in Bandung regency more complete. In addition, information on damaged roads and their repair status can be easily accessed by the public and historical data on damaged roads is documented.

II. STUDY LITERATURE

This section will explain more about Geographic Information System and GDSS:

A. Geographic Information System

Geographic Information System is a special information system that manages data that has spatial information (spatial reference). Or in a narrower sense, is a computer system that has the ability to build, store, manage and display geographic information, such as data identified by location, in a database. The practitioners also include the person who builds and operates them and the data as part of this system [6].

Geographic Information System Technology can be used for scientific investigation, resource management, development planning, cartography and route planning. For example, GIS can help planners to quickly calculate emergency response times during natural disasters, or GIS can be used to find wetlands that require pollution protection [6].

B. GDSS (Group Decision Support System)

The group decision support system is a computer-based information system used to improve group decision making in an organization. The group decision support system is a computer-based information system used to improve group decision making in an organization. The group decision support system provides the provision of something that supports communication for members of the group [7]. The group decision support system as a system that combines
communication, computing, and decision-making technologies to facilitate unstructured formulation and problem solving by a group of people. Most group decision support systems are designed to help make groups more productive by supporting the exchange of ideas, opinions, and preferences within the group [8].

III. RESEARCH METHODOLOGY

The methodology used in developing the application of geographic information system is web-based is Extreme Programming methodology. Extreme Programming was chosen because XP is a model included in the agile approach introduced by Kent Back. According to his explanation, the definition of XP is as follows: "Extreme Programming (XP) is a software development method that is fast, efficient, low risk, flexible, predictable, scientific, and fun" [9].

Figure 1 Stages in XP [9]

This model tends to use the Object-Oriented approach. Stages that must be passed include: Planning, Design, Coding, and Testing. Extreme Programming Goals are teams of small to medium size, no need to use a large team. This is intended to deal with unclear requirements and rapid changes in requirements. Extreme Programming is the most widely used agile method and a very popular approach [9].

IV. RESULT AND ANALYSIS

A. System Infrastructure Requirements

Infrastructure is a basic physical and non-physical need in organizing a structural system. This section will describe the required system infrastructure briefly. The system requirement is shown in Table I. To make the system running, it is needed virtual private server (VPS). In the VPS, it is required that the server is installed with Ubuntu server and the database that is used is postgresql. Apache and python is needed to run the web service and GIS based service with Django.

B. System User

This section describes in more detail the system users and their role to the system.

C. System Features

Feature is an aspect, quality or prominent features. This section describes the features of the system as well as the description of each feature and user who can access or use the feature.

Table I

<table>
<thead>
<tr>
<th>No.</th>
<th>Requirements</th>
<th>Name</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Virtual Private Server</td>
<td>Digital Ocean Droplets</td>
<td>Standard Droplets</td>
</tr>
<tr>
<td>2</td>
<td>Installed Software</td>
<td>Ubuntu Server</td>
<td>16.04.4 LTS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Postgresql &amp; Postgis</td>
<td>9.5++</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GDAL</td>
<td>2.2.3++</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Apache</td>
<td>2.4++</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Python</td>
<td>2.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Django</td>
<td>1.11</td>
</tr>
<tr>
<td>3</td>
<td>Domain name</td>
<td>Domain .com</td>
<td>TLD</td>
</tr>
</tbody>
</table>

Table II

<table>
<thead>
<tr>
<th>No.</th>
<th>User</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Community</td>
<td>Access and input damaged road data</td>
</tr>
<tr>
<td>2</td>
<td>Admin</td>
<td>Taking care of infrastructure system</td>
</tr>
<tr>
<td>3</td>
<td>Department of Public Works</td>
<td>Access and Input damaged road data and make decisions from available data</td>
</tr>
</tbody>
</table>

Table III

<table>
<thead>
<tr>
<th>No.</th>
<th>Features</th>
<th>Description</th>
<th>User</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reporting Road Damage</td>
<td>Community/Admin/Department of Public Works can report the damages road</td>
<td>Community/Admin/Department of Public Works</td>
</tr>
<tr>
<td>2</td>
<td>Viewing Damaged Road Information</td>
<td>Community/Admin/Department of Public Works can see the data of unfixed damaged road</td>
<td>Community/Admin/Department of Public Works</td>
</tr>
<tr>
<td>3</td>
<td>Viewing Damaged Road Information</td>
<td>Community/Admin/Department of Public Works can see the data of fixed damaged road</td>
<td>Community/Admin/Department of Public Works</td>
</tr>
<tr>
<td>4</td>
<td>Administrator Login</td>
<td>As administrator</td>
<td>Admin/Department of Public Works</td>
</tr>
<tr>
<td>5</td>
<td>View Road Damage Report Details</td>
<td>Admin can see the damaged road detail</td>
<td>Admin/Department of Public Works</td>
</tr>
<tr>
<td>6</td>
<td>Changing the Road Repair Status</td>
<td>Admin/Department of Public Works change the status of the damaged road</td>
<td>Admin/Department of Public Works</td>
</tr>
<tr>
<td>7</td>
<td>Viewing GDSS Recommendation Results</td>
<td>Admin/Department of Public Works see the recommendation of which one should be fixed at the first</td>
<td>Admin/Department of Public Works</td>
</tr>
</tbody>
</table>
D. Use Case Diagram

Use case diagram is a diagram used to describe the application functionality of each user using the application. [10] [11] [12] [13].

![Use case diagram]

Figure 1 Use case diagram

E. Activity Diagram

Activity diagrams in this system describe each activity performed by each actor. Activity diagram is based on the results of use case diagram that has been previously defined. [10] [11] [12] [13]. In the above use case there are seven activities that can be done by the user, here is a description of the activity diagram.

![Activity diagram of reporting damaged roads]

Figure 2 Activity diagram of reporting damaged roads

In Figure 3 the activity diagram of the systematic reporting of damaged path consisting of the user until the user reports are stored.

![Viewing Unfixed Broken Road Information]

Figure 3 Activity diagram see the damage road information has not been fixed

In Figure 4 is the activity diagram of the process of viewing the systematic information of damaged roads that have not been repaired so that later users can find out which path information has not been fixed.

![Viewing Fixed Broken Roads]

Figure 4 Activity diagram see the damaged road information has been fixed

In Figure 5 is the activity diagram of the systematic process of viewing damaged road information that has been fixed so that later users can find out which path information has been fixed.
Figure 5 Activity diagram administrator login

Figure 6 is an activity diagram of the systematic administrator login wherein this administrator will manage the application.

Figure 7 Activity diagram change the status of damaged road repair

In Figure 7 is an activity diagram for systematic processes to change the status of road improvements that can only be performed by the admin.

Figure 8 Activity diagram see details of damaged road

In Figure 8 is an activity diagram for systematic processes to see the detail of road damage where admin and user will be able to know the detail of road damage and can be used as one of the considerations in the priority of road improvement.

Figure 9 Activity diagram see the GDSS recommendations

In Figure 9 is an activity diagram for systematic processes looking at the results of a GDSS recommendation that can only be performed by the admin.
F. **Data Flow Diagram**

Data Flow Diagram (DFD) is a diagram that uses notations to describe the flow of system data, whose use is helpful to understand the system logically, structured and clear. In this section will explain the data flow diagram of the research system used. [10] [11] [12] [13].

![Data flow diagram 0 level](image1)

**Figure 9 Data flow diagram 0 level**

![Data flow diagram 1st level](image2)

**Figure 10 Data flow diagram 1st level**

Figure 11 illustrates the systematic process of the Data flow diagram at level 1 or functionally.

![Entity relationship diagram](image3)

**Figure 11 Entity relationship diagram**

G. **Entity Relationship Diagram (ERD)**

ERD is a useful diagram to explain the relationship between existing data in the database. One table in the database represents one data entity. In the ERD described data entities as well as attributes on each entity. [10] [11] [12] [13]. Here is the ERD for the application.

![User interface damaged report road](image4)

**Figure 12 User interface damaged report road**

H. **User Interface**

The user interface is a graphical display that relates directly to the user. The user interface works to connect between users and the operating system, so that the computer can be used. This section shows how the user interface of the system is being studied. [14].

![User interface damaged road has not been repaired](image5)

**Figure 13 User interface damaged road has not been repaired**
I. Advantages and Disadvantages of the System

From the system design that has been done can be analyzed the advantages and disadvantages. Here are the advantages of the system that has been designed:

1. Involving the community in decision making.
2. The number of short user interconnections.
3. Provide information on the road repair status.
4. Intuitive easy-to-understand design.
5. Anonymity of the complainant

Here are the disadvantages of the system that has been designed:

1. Security of arbitrariness of users who report fictitiously damaged roads resulting from anonymity of users.
2. No analytic road is broken.
3. Details of damaged roads are not available to the public.

V. CONCLUSION

The design of geographic based decision support system for road improvement with GDSS method that has been made in this study aims to assist the Public Works Department to take a road repair and road damage information system in Bandung regency and also at the same time as media reporting damaged road by the community. In more detail, here are the features already created on the system's grid:

1. Report road damage, can be done by community and admin.
2. Viewing damaged road information has not been improved, can be done by the public and admin.
3. Viewing damaged road information has been improved, can be done by the public and admin.
4. Administrator login, can only be done by Public Service as admin.
5. See details of road damage, can only be done by the Public Works Service as an admin.
6. Changing road repair status, can only be done by Public Works Service as admin.
7. Seeing the GDSS recommendations, can only be done by the Public Works Office as an admin.
REFERENCES


